Pollen Effects on Asthma, Allergic Rhinitis and Finger Wound Emergency Department Visits Between 2000-2010 in Baltimore, Maryland

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Background

Many factors contribute to respiratory-allergic disease onset, especially asthma[1-7]. Published studies have demonstrated that pollen levels influence the onset of a respiratory disease such as asthma[4, 6-7]. Up to now pollen effects on asthma have not been reported for the State of Maryland. To understand how pollen quantity and type contribute to the onset of respiratory diseases this study implemented these methodological improvements: 1) Use of 11 years of pollen readings from the only National Allergy Bureau (NAB) certified pollen counting station in Maryland. 2) Availablity of 11 years of Emergency Department (ED) visits for asthma and allergic rhinitis, and a non-respiratory disease control group composed of finger wound injuries. 3) Evaluation of the distance hypothesis for pollen effects on respiratory disease ED visits. 4) Evaluation of ambient temperature on pollen levels during the same 11 year period. It was anticipated that: 1) Pollen-specific effects should be restricted to asthma and allergic rhinitis ED visits, and exclude finger wound injuries. 2) Ragweed pollen should be more allergenic than tree or grass pollen. 3) Pollen effects on asthma and allergic rhinitis should continue to decrease as the distance between the pollen counting station and the patients' county of residence increases. 4) There should be a positive association between ambient temperature and pollen level.

Methods

1) Health Data: Asthma, ICD-9-CM code of 493 (n=302,866); Allergic Rhinitis, ICD-9-CM code of 477 (n=56,598); Finger Wound Injuries, ICD-9-CM code of 883 (n=152,607).
ED visits data were obtained from the Maryland Environmental Public Health Tracking Program. The original data steward was the Maryland Health Services Cost Review Commission.

2) Pollen Data: National Allergy Bureau (NAB) certified pollen counting station, Owings Mills, Maryland. Pollen readings were recorded from February through October. An intermittent Rotorod unit was used. It was positioned about 30 ft. above the ground. Eleven years of pollen grain readings were available for tree, grass, weed and ragweed. Please refer to Figure 1, State map, for location of NAB certified pollen counting station.

3) Temperature: Monthly temperature readings, in degrees Fahrenheit, were obtained from Baltimore Washington International (BWI) Airport[8]. The linear distance from BWI to the pollen counting station was 22.3 miles, based on Google Maps.

4) Confounders: The two confounders controlled were ozone and fine PM. The linear distance between the Padonia air monitoring station (Cockeysville) and the pollen counting station in Owings Mills was 14.2 miles, based on Google Maps[9]. Figure 1 shows the location of the criteria air pollutant monitoring station.

Distance Group [n(%)]	Asthma		Allergic Rhinitis		Finger Wounds		Population	
	(n=302,866)		*(n=56,598)*		*(n=152,607)*		*(n=4,394,527)*	
0-10 miles	177,633	(59)**	29,725	(53)**	63,910	(42)**	1,603,985	(37)**
11-20 miles	48,998	(16)**	10,367	(18)**	41,668	(27)**	1,077,966	(24)**
21-30 miles	76,235	(25)**	16,506	(29)**	47,029	(31)**	1,712,576	(39)**

Table 1: Total (Percent) ED visits for asthma (1st column), allergic rhinitis (2nd) and finger wound injuries (3rd) and population (last) in the three distance groups.

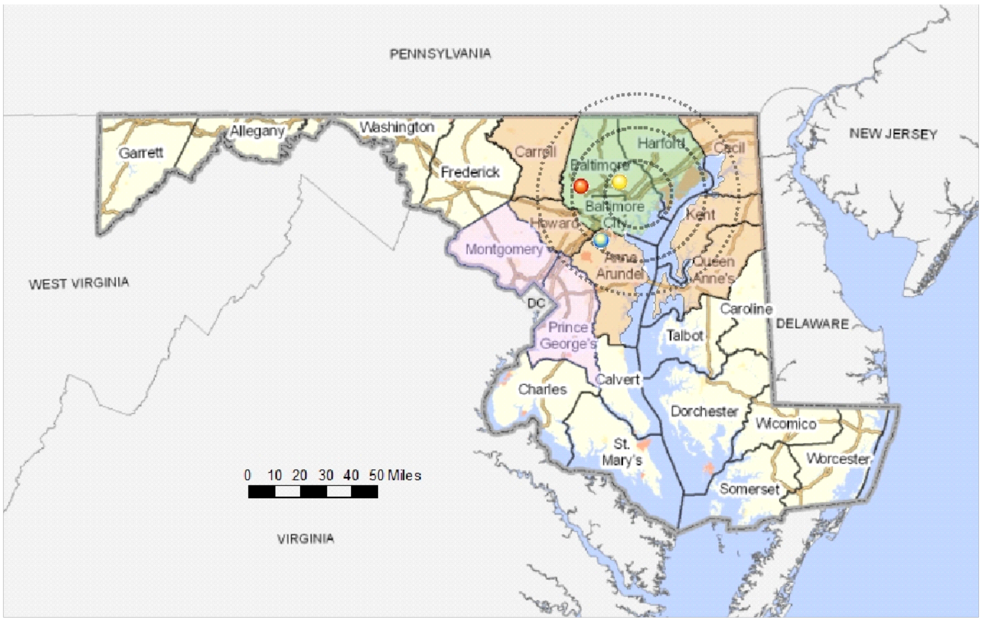

Figure 1: Map shows locations for the pollen counting station in Owings Mills (red), BWI airport for temperature (blue) and Cockeysville for criteria air pollutants in (yellow).

Maryland jurisdictions in three distance groups shown in Table 1 and Figure 1: 1) 0-10 miles: Baltimore, Baltimore City and Harford; 2) 11-20 miles: Carroll, Queen Anne's, Anne Arundel, Cecil, Kent and Howard; 3) 21-30 miles: Prince George's and Montgomery.

Data Analyses

Data analysis Steps: 1) Data were first aggregated by county and month, then concatenated. 2) Linked files were analyzed using Proc GENMOD in PC SAS 9.3. 3) Poisson transformation and Negative Binomial were used prior to the analysis of the linked files[10-11]. 4) Alpha was set at $p<0.05$ for all analyses. 5) Three circles were created, each with a radius of 10 miles from the pollen counting station, to evaluate the pollen distance hypothesis (see Table 1 and Figure 1). 6) Correlation and partial correlation analyses were carried out between pollen and temperature.

Results

1) Pollen Effects on ED Visits: Asthma--Significant contribution for the 2nd quartiles for both weed (OR=1.18, 95% CI =1.09-1.28) and ragweed (OR=1.29, 95% CI =1.14-1.47). Allergic rhinitis--Significant contributions for the 3rd quartile of tree (OR=1.20, 95% CI =1.11-1.30) and grass (OR=2.01, 95% CI =1.80-2.23). Finger wounds--Significant results were not clearly discernible. But, the 2nd quartile for weed pollen (OR=1.11, 95% CI =1.06-1.16) was significant.

2) Odds Ratios (ORs) by Year, 2001-2010 Relative to 2000 for Asthma, Allergic Rhinitis and Finger Wound Injuries are Shown in Figure 2:

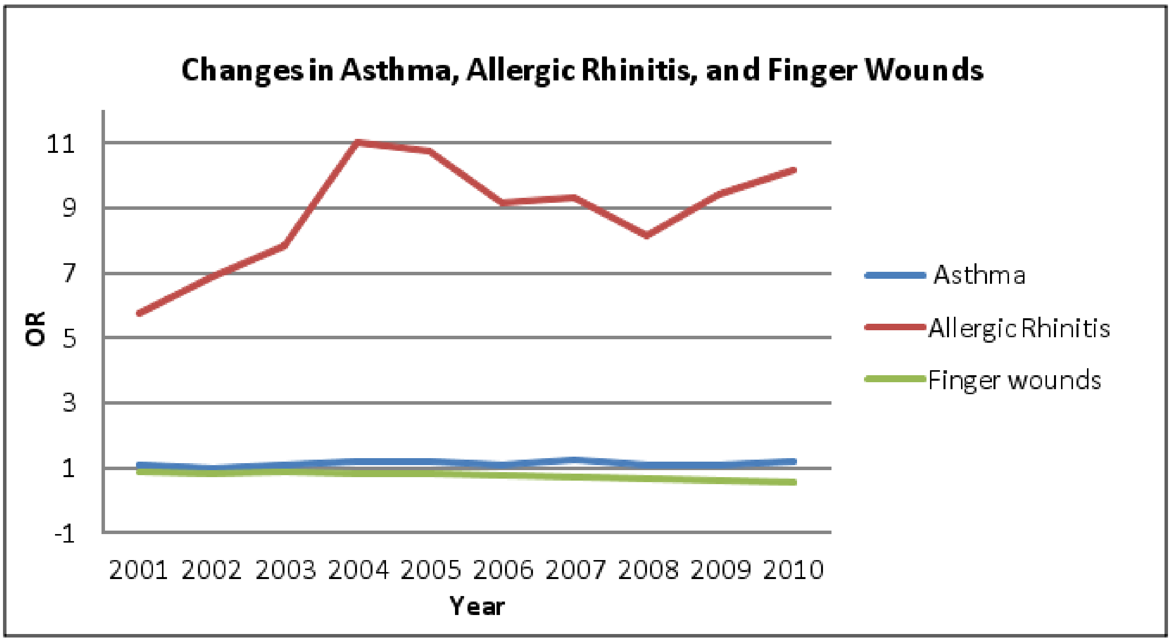

Figure 2: ORs for the three groups from 2001-2010, relative to 2000.

3) Distance Effects of Pollen: 0-10 miles: asthma (OR=2.81, 95% CI =2.66-2.97); allergic rhinitis (OR=1.74, 95% CI=1.65-1.84); finger wounds (OR=1.30, 95% CI=1.26-1.35). 11-20 miles: asthma (OR=1.22, 95% CI =1.14-1.32); allergic rhinitis (OR=0.86, 95% CI =0.80-0.92); finger wounds (OR=1.28, 95% CI =1.23-1.33).

4) Climate Change Proxy Measures: All pollen types were significantly correlated with temperature in unadjusted and adjusted analyses. Shared variance (r^2) increased in the adjusted analyses, after the confounding effects of the two criteria air pollutants, fine PM and ozone, were controlled (see Table 2).

		Unadjusted		Adjusted		Difference
		Temperature	R^2 (%)	Temperature	R^2 (%)	R^2 (%)
Pollen (Average)	Total	-0.10**	1	-0.35**	12.3	11.3
	Tree	-0.14**	2	-0.39**	15.2	13.2
	Grass	0.26**	6.8	0.07*	0.5	-6.3
	Weed	0.40**	16	0.57**	32.5	16.5
	Ragweed	0.29**	8.4	0.58**	33.6	25.2

Table 2: Unadjusted and adjusted correlations between pollen and temperature.

Discussion

To our knowledge, this is the first study on the effects of pollen on a respiratory disease for Baltimore City/County or Maryland. Pollen does contribute to significant increases in asthma and allergic rhinitis ED visits in a way that is qualitatively different from the effects of pollen on finger wound injuries. Ragweed pollen produced greater allergenic effects on asthma and allergic rhinitis than tree or grass pollen. The distance hypothesis analysis demonstrated a stronger contribution of pollen within the 0-10 miles than 11-20 miles, relative to the control distance of 21-30 miles. These results offer evidence that pollen effects are not uniform over long distances, as some authors have assumed[5-7].

An unexpected outcome was the non-linear relationship between pollen and finger wound injuries. We selected finger wound injuries because pollen effects are not mediated through a respiratory mechanism. But, this complex, and qualitatively different relationship between pollen and finger wound injuries, suggests that pollen can indirectly contribute to finger wound injuries in ways that are not yet fully understood, e.g., disorientation and inattention as precursors to a finger injury.

Even though this study included several methodological improvements, these results should be intrepreted with caution. These analyses were completed on aggregated observations. We do not know if the results will be the same as would be obtained if individual records were used in the analyses.

We found that temperature, pollen and respiratory ED visits were higher at the end than at the beginning of the 11 year data analysis window. Under some circumstances it may be possible to use 11 years of pollen and temperature readings as a proxy for climate change effects.

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Footnotes

1) These results were based on the work completed by the first author as part of her MPH thesis at the University of Maryland School of Public Health, College Park.

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